THE ZOOLOGIST

No. 884.—February 15th, 1915.

THE SENSE OF DIRECTION.

By J. M. Dewar, M.D.

The "sense of direction" is a term used to denote the unknown means which enables birds and other animals to return to the localities they have left. The phrase also applies, though with less propriety, to the mechanism by means of which migratory animals proceed to regions they do not know, whether these regions have been occupied by the animals' progenitors or not. In the observations herein recorded the sense of direction is considered from the aspect of the animals' environment. The environment plays a part in the formation of the guiding mechanism by providing data which may be used by the organism in finding its way from one place to another. As it happens, the immediate problem of a directive sense really turns on the nature and extent of the external factors employed. At the same time, the value of the possible factors can only be determined when due regard is paid to the kinds of sensory organs possessed by the animals, and also to the probable degree of efficiency which the sensory organs concerned and the associated nervous processes attain.

Regarding the nature of the directive mechanism two historic theories may be said to hold the field. The one, strange to say, has been supported mainly by workers with insects, and is briefly a "memory of localities," or a "knowledge of landmarks"; the other has been applied conspicuously to the higher animals, and is a capacity to sense the position of the objective in terms of

the bodily displacements in space experienced on the outward journey.

An extensive literature has accumulated around these two theories. Among birds, most of the experimental work has been performed on Carrier Pigeons. The results, too numerous to be detailed here, show that the experimenters, for the most part, prefer the theory of a knowledge of landmarks. In this view they are in general agreement with most of the workers on insects. On the other hand, some of the most distinguished students of avian migration have maintained the inadequacy of the theory to account for the long oversea journeys of migrating birds. And, it may be remarked, a sufficient number of trials has been recorded to show that Carrier Pigeons are able to return home across the open sea, that is, without the help of a knowledge of landmarks. The second theory also presents difficulties under conditions in which the objective, or a landmark on the way to that point, is visible from the beginning of the flight, and it is not a complete explanation of the mechanism of long oversea journeys.

It is convenient at this stage to propose a division of the phenomena of homing flight into three classes on a negative basis produced by the various considerations which have just been resumed. By the allocation of a given flight to a particular class, the subsequent search for the directive factors will be facilitated. The divisions are as follows :—

Class 1. In which at the time of departure visual perception of the objective cannot be excluded.

Class 2. In which visual perception of the objective may be regarded as impossible, and in which the guiding influence of land dispositions cannot be excluded.

Class 3. In which there is no visible means of guidance of any kind.

Instances assignable to each class will occur to everyone. The first and second classes invite the very evident explanatory theory of a memory of localities. For the amazing flights performed by birds, and coming within the third class, this theory is obviously invalid.

The directive mechanism readily admits of analysis into two component parts. The first component is the means which

primarily determines the direction of flight, and it may be regarded as static in operation. The second component is the means by which a true course is kept, and it is dynamic in mode of operation. While it fulfils the conditions of the first component, the theory based on a sense of displacements does not adequately comprise those of the second. For, if a persistent wind blows across the track of birds travelling a long way over open water, then the birds are faced with the difficulty of neutralizing drift, as Darwin pointed out.* Should the travellers have no perception of a strong leeward drift from their true course, then at any given part of the journey the birds will not point towards their destination, but along a line which is parallel to the original course projected from the point of departure. Such a misfortune might readily be attributed to birds far beyond sight of land. Nevertheless, it is advisable to believe that birds possess the power to correct deviation in the absence of landfalls.

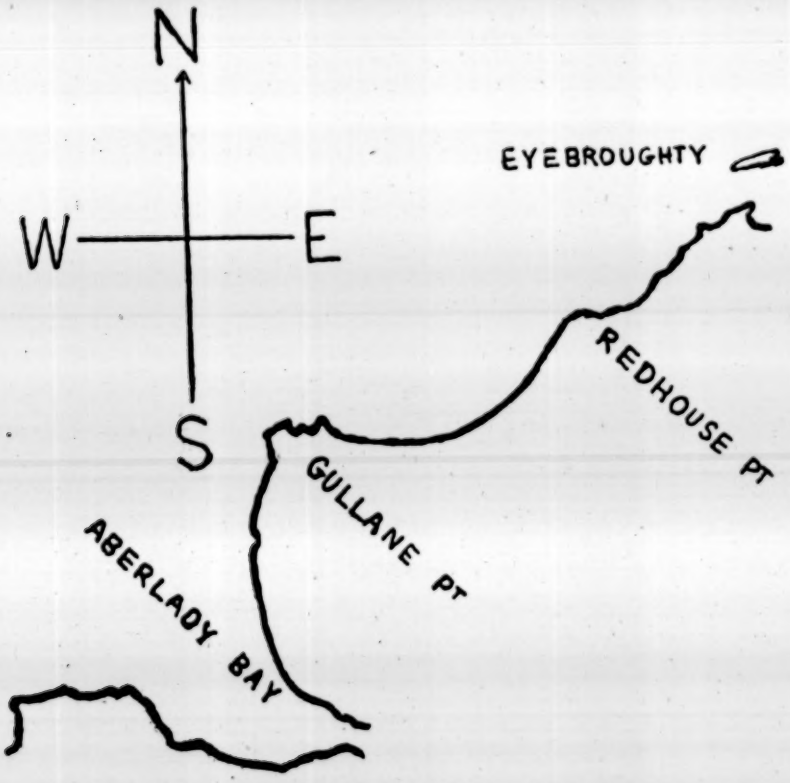
The observations which I am about to record tend to show that the theory of a sense of displacements accounts for the first component of the sense of direction more satisfactorily than the theory of a memory of localities; that a memory of localities is not employed under conditions in which one would expect a useful knowledge of landmarks to be demonstrated; and that the former theory does not sustain the keeping of a true course.

Obs. 1.—Fog. Visibility range 1500 yards. Wind N.W., 1. Twelve Geese from inland on course N. by E. magn., made the sea at Redhouse Point, East Lothian, and turned W.N.W. After going so far on this course, the three leaders turned about S.W.; the rest continued W.N.W. for some time, and then followed the leaders. They were thereafter watched going S.W. along the coast of Gullane Bay as long as they were visible. The Geese invariably rest in Aberlady Bay after having been inland. The direct line from Redhouse Point to Gullane Point was afterwards found to be W.S.W. magn.

Obs. 2.—Fog. Visibility range 300 yards. Calm. Observation made from "sill" opposite Eyebroughty Brig, Firth of Forth. The usual flight of waders, during high water of spring

* Darwin, "Posthumous Essay on Instinct," 1859. Appendix to 'Mental Evolution in Animals (Romanes),' p. 357.

tides, from Aberlady Bay to Eyebroughty, takes place on a straight course from Gullane Point to the west end of Eyebroughty. To-day Oystercatchers only were observed. They were heard repeating the "pik" call for some time before they were seen, and the sounds came along the mainland coast which



SKETCH-MAP OF THE COAST. Scale: one knot to the inch.

the birds proved to be following. They passed the "sill" and were going further eastward, when their calls were answered by a single clear trill coming from a bird of the stock resident on Eyebroughty. The flock turned immediately and abruptly, and flew in silence in the direction of the sound, their safe arrival being indicated by a fog-subdued whistling coming from the same region.

On the return journey, when the visibility range had risen to about a thousand yards, the birds left Eyebroughty in successive bands which approached the mainland westward of the "sill," and turned right-handedly to coast instead of following

their usual practice of flying directly to Gullane Point. (Eyebroughty is nearly 400 yards distant from the nearest point of the mainland.)

According to the state of the weather these observations range themselves in one or other of two of the three classes of migratory movements. In a clear atmosphere they belong to the first, and in foggy weather to the second class. Certain considerations will, I think, make this clear. The Geese and the Oystercatchers were travelling, in the one instance daily, in the other frequently, towards objectives which were ordinarily visible from the beginning of flight. When the weather is clear the Geese are remarkably constant in their line of flight to and from the inland feeding grounds, regularly following a course which lies nearly parallel and close to the long axis of the Bay, and it is noteworthy that they then neutralise drift unless the wind is exceptionally strong. In fog with a light westerly breeze they fail to make up leeway in returning to the Bay, and strike the coast, it may be, a mile or more eastward, when they redirect themselves towards the Bay. It does not appear that the usual height at which the Geese fly makes the ground below invisible to them when the range of human vision is not less than that of the second observation. The uniform failure to make up leeway in a number of observations suggests, though it does not prove, that the Geese habitually orient themselves by direct sight of the Bay, and have no cause to pay heed to the landmarks in passing. The evidence, however, is not so strong as it might be, as there is always the possibility that in some considerable portion of the flight the land was hidden from the birds by the fog.

The Oystercatchers furnish more valuable evidence on this matter. The basaltic sill opposite to Eyebroughty is a conspicuous and distinctive feature of the landscape. It is also unequivocally the shore landmark for the Brig, and the birds are often enough on the Brig to become familiar with the landmark if they wished or were able. Yet the birds actually passed the sill, and their course was changed in a fraction of a second after the trill was uttered. It is clear that the actual course of events depended on the trill, and not on recognition of the basaltic rock. Had the calls not been answered by a trill

from a bird on Eyebroughty, the flock would have gone out to sea. It is, therefore, probable that in the flights to Eyebroughty the landmarks passed on the way are not recognised.

The second result of the observations approaches the problem of the second component. The Oystercatchers did not venture to follow the direct "oversea" route from Aberlady Bay, as they always do in clear weather. The fog would have hidden them from the land for the whole of the journey—a distance of nearly three miles—and they would have been compelled to direct themselves with sufficient accuracy to strike a rock which has a breadth of only fifty yards. Instead they followed the coast-line, there is every reason to believe. It is true they were known to do so only as long as their calls were audible. But previous fragmentary observations made at several points further west render it probable that in fog the birds hug the coast the whole way. When the return journey was begun the birds turned westward correctly, and without hesitation on striking the coast of the mainland. They knew that Aberlady Bay lay to the west. But their means of keeping a true course was not sufficiently adjusted to enable them to proceed in fog on the direct course over the sea. The observations on the Geese tend to confirm this conclusion. On reaching the shore the Geese changed their direction of flight to the westward, and showed a general knowledge of the position of Aberlady Bay. On the assumption that the new direction of flight was correctly observed, there was, however, a difference of 45° between the magnetic course taken by the Geese and the magnetic bearing of Aberlady Bay.

From these observations we may grant the birds had at least a constant knowledge of the general whereabouts of the place or places to which they were impelled to go. A knowledge of landmarks was not acquired, though such were available on many occasions. The means of correcting drift was not adequate in fog. On the other hand, the observations throw no light on the use or disregard of the objective as a guide when that is possible. Nor do they clear up the nature of the mechanism of the first and second components. On these matters further information is required.

A Canary which had the liberty of a room was in the habit

of flying many times a day from one end of the room to the door of its cage. When the cage was removed a distance of a few feet to one side, I found that the Canary flew to the exact spot where the door had been.* It is thus apparent that the Canary had a knowledge of the position of the cage door in space, and that it did not need to look for the entrance in order to fly accurately towards it from a distant point. Visual perception of the objective, as a means of guidance, was therefore not used by the Canary in making habitual flights.

Topham and others, especially Bethe, arrived at a similar result with Bees, the latter emphasising the idea of a locality in space as the virtual nature of the destination, a remarkable circumstance long since recognised, for Thompson records that Bees "know their hive more from its locality than from its appearance." Watson made analogous experiments on Terns, and with like results.† He was able to show that the environment, the egg, and the nest itself, could be eliminated, or completely altered, without affecting the capacity to return to the immediate locality of the nest, and it is this—the locality of the nest—that Prof. Watson regards as the principal factor in homeward orientation. From the results of his experiments Prof. Watson suggests that "if adjustment (*i.e.* to the nest) is made in terms of visual data, the visual environment which serves as the stimulus must be complex and have a wide extension." But he is not prepared to admit that adjustment takes place in terms of vision alone. These experiments are particularly valuable in that they were made on birds whose European representatives, according to Slonaker, are capable of binocular vision.‡ My own observations apply to birds which have only one area for clear vision in each eye, and which apparently do not have binocular vision. Thus, in spite of the capacity to see clearly ahead, the Terns were not aware of any

* The experiment was repeated almost daily, and often unintentionally for several years on the same bird, and on a second Canary for a shorter period. No material variation in the result was observed.

† Topham, 'Nature,' April, 1874, p. 484; Bethe, Pflüger's Archiv. Bd. lxx. s. 72, 1898; Thompson, 'Passions of Animals,' p. 53, 1851; Watson, 'Carnegie Institution, Washington,' Publ. No. 103, p. 227, 1908.

‡ 'Journal of Morphology,' vol. xiii. p. 445, 1897.

changes in the locality of the nest until after they arrived, while in those birds without binocular vision a clear perception of the objective can only be obtained by turning the head to one side.

Direct vision of the objective is not required by certain diving birds, which are able to fly distances of from one-half to two miles over the sea to feeding areas of small extent and lying two to five fathoms under muddy water. The absence of landway after the first dive forms a test of the accuracy of the orientation, which, indeed, rarely errs by more than a few yards.

It is thus possible to exclude the use of an immediate visual perception of the objective and a knowledge of landmarks, even though these are available, when it is clearly recognised that habitual flights of longer or shorter duration can proceed towards a successful conclusion without the aid of either of these methods of orientation. And therewith we exclude the whole environment from the mechanism of the first component of the directive sense. The advantage so far gained lies in the circumstance that, whether the flights extend over a few yards or several hundreds of miles, the mechanism of the first component is reduced to one kind only—is the same for all habitual flights.

The data on which the first component rests must then be internal and independent of the environment. To account for the nature of the internal data, Bonnier put forward the theory which is based on the sense of displacements.* Bonnier asserted that there is no known instance of an animal making a definite movement to a certain place where it had never been, and, so far as I am aware, the assertion is still true to-day. All movements made by animals with the object of reaching definite localities are return movements. Further, the capacity to return to the original point of departure does not extend over unlimited distances. The limitation suggests a mechanism dependent on a knowledge of places, and it has, indeed, been so interpreted. But the objections to this view are too weighty to be overcome. From the two facts just cited it is apparent that the mechanism of the first component is dependent on impressions acquired on the outward journey, and that these impressions are internal and not due to the environment is maintained by the

* Compt. Rend. Soc. Biol. t. iv. p. 1051, 1897.

proven ability of animals to return safely home though they are carried in closed receptacles on the outward journey, through a country they cannot possibly know. Bonnier, with regard to human orientation, considered that a knowledge and memory of all the series of displacements, since the point of departure was left, are sufficient to keep us constantly in touch with this point, or we may exert ourselves, perhaps unconsciously, to maintain always the notion of its direction in the course of our displacement, but without preserving a memory of our successive displacements. So many instances are known of animals returning by a different route from that along which they set out, or were carried, that a memory of the successive displacements may be dismissed as unnecessary. The alternative proposed by Bonnier is more in keeping with the facts as they are known to occur in animals. As each displacement occurs and is sensed, the bearing of the point of departure is readjusted in terms of the extent and direction of the displacement, but a memory of the displacement is not necessarily retained, and there is no subsequent readjustment in terms of memory. There may thus be a constant knowledge of the position of the point of departure, but there must evidently be a limit to the formation of associations on this basis, just as much as there is to the formation of associations on the basis of landmarks.

While Bonnier's theory is the most probable expression of the mechanism of the first component, the theory contributes nothing to the working of the second component. The superlative need of being able to keep a true course is indisputable. The ability is wonderfully developed in flying insects and birds, and it plays no inconsiderable part in successful orientation.

The Canary's cage stood in a window recess and was always clearly lighted for a considerable time after sunset, but the room was apt to grow rapidly dim. Observations extending over several years proved that the Canary had then considerable difficulty in returning to its cage, that it frequently failed to keep a true course, and that it circled the room repeatedly. This result speaks for visual impressions as a factor in the perfection of the second component of the sense of direction.

I have already quoted some observations to show that the

field of clearest vision in the flying bird lies in an antero-lateral relation to the bird rather than directly ahead. The bird has a simultaneous visual perception of objects lying on both sides of itself. Owing to the rapidity of its flight and a preoccupation with the object of flight, the bird does not form any definite notions as to the nature and position of neutral objects, but is concerned rather with wide surfaces and extensive lines occupying the visual fields. These surfaces and lines are used not to direct the course followed, but to preserve the straightness of the course originally projected from the starting point. Distances, then, rather than objects furnish the data for keeping a true course. And as birds fly with equal facility from all quarters towards their object, there can be no memory of the lateral distances at the successive points on the course projected. Hence the data are not geographical but mechanical. Continuous observation, it need not be consciously, of the surfaces and lines lying towards the limit of both lateral horizons furnishes a more delicate test of the straightness of the course that is being kept than binocular concentration on the objective lying directly ahead. The idea, it may be noted, is not purely speculative, for in some degree it can be given the trial of personal experience. The explanation just given accounts for the Canary's failure to reach the well-lighted cage when the room was dim, the more so as the lateral deviation, when it arose, occurred towards the really darker, or the farther away and therefore apparently darker, side of the room.

In more general relations it should be borne in mind that, though the flight of small birds is often ill-directed in semi-darkness, these birds, when they are migrating at night—as Gätke has pointed out—have no apparent difficulty in keeping their course.* Audition here is a possible factor of the second component; the more so as Prof. Watson found by observation at night that the erratic flight of individual Terns was corrected when their calls were answered from the nest.† At the same time, it cannot be said that visual data based on fixed lines and surfaces are essential to the mechanism of the second component, for none is present on the open sea. Gätke observed

* 'Heligoland as an Ornithological Observatory,' p. 63, 1895.

† *Loc. cit.* p. 217.

that migration was arrested when the sky was completely overcast, but it was resumed after less or more of starlit sky became visible. Possibly, we are here in touch with a visual factor of great importance, though of an unknown nature. It appears as if the sea, the sky, and the horizon, in whole or in part, furnish surfaces and lines of definite value, and as effective for the second component as the fixed surfaces and lines of the landscape. Most often in Nature the second component is disabled by the presence of haze or fog. Probably the absence of relatively fixed points in an atmosphere laden with condensing vapour makes the keeping of a true course impossible. If the bird continue its journey, drift may set in and pass unnoticed.

We have seen that the environment is able to furnish surfaces and lines for the maintenance of a true course. To a rapidly moving bird or insect these surfaces and lines must present the appearance of running contrary to the animal's direction of motion. Any divergence from the proper trajectory of flight alters the relative distances and the apparent direction of motion in the environment which must have the widest possible extension in order to prevent local peculiarities throwing the animal off its course. Now, if we suppose a bird in flight to be pointing towards its objective, and to be drifting before a wind blowing across its course, the definitive surfaces and lines coming within the visual fields will appear to run not directly but to curve obliquely backwards, the obliquity being inclined towards the wind. The oblique distortion of the environment and the peculiar alteration of the lateral distances relative to the bird will compel it by force of habit to correct the displacement. This the bird can only do by altering the axis of its body to an alignment lying between the direction of the wind and the course towards the objective. As it happens, birds actually do so whenever the cross-wind is of sufficient strength to set up drift. In general terms the deviation of the bird's axis, as estimated at the anterior end, is always towards the wind, whether it blows before or abaft the beam. Hence the bird has a constant tendency to eat into the wind a little, and the appearance of birds flying under these conditions suggests that the deviation to windward is proportional to the strength and direction of the wind, and automatically sufficient to

neutralise drift, provided the wing-power is adequate. The test for the last requirement can only be the environment in its widest extent.

The argument may be led against a second component based on visual impressions that the existence of an analytical mechanism under the first component, and dependent on an internal sense of displacements, renders the second component unnecessary. The contention is justified with regard to certain animals which, conditionally or otherwise, receive little or no external impressions. In these animals the first component is evidently very highly developed, and in itself is possibly adequate to compass the return home. But in birds and many insects the relatively great efficiency of the visual organs has, there are reasons to believe, militated against a gradual refinement of the sense of displacements to a grade of efficiency sufficient to control the course, which must be a "bee line" to be serviceable. As much is proved by the effect of fog and total darkness. These, as we have seen, destroy or disable the faculty of distant orientation. They do not, however, obliterate the knowledge of the position of the objective in space, for this knowledge remains intact. But the means of getting there is, for the time being, partially or completely lost.

Whenever the sense of direction for one reason or another fails, a return to the original point of departure is possible only by a visual re-orientation on that point of departure. As much is evident from some of Prof. Watson's experiments and from the Canary, which, after its cage was retained in a new position for some time, had to look for the door of the cage before it was able to return. Evidence as to the linear distance over which visual re-orientation can be accomplished is available, so far as I am aware, for Pigeons only. Hachet-Souplet left Pigeons at a certain place, and moved the cote to conspicuous positions at increasing distances from that place. When the separation amounted to more than ten or twelve kilometres, the Pigeons failed to return home.* It is thus evident that the appearance of the home, or original point of departure, is intimately associated with its position in space; and that, when the two are

* VI. Congrès Internat. de Psychologie, p. 663, 1910.

severed by more than a moderate distance, the knowledge possessed by the bird of the appearance of its home is not sufficiently accurate—or, at any rate, dominant—to overcome the confusion resulting from the disturbance of its position in space.

To summarize: the sense of direction is an expression of the means by which an animal is able to return to any locality it has recently occupied. The sense of direction is susceptible of analysis into two components. The first component is a constant knowledge of the position of a locality in space. It is internal in origin; that is, independent of the environment, except in so far as the sensation of space is attached to the external world, and is probably a capacity to sense the position of the objective in terms of the bodily displacements in space experienced during the outward journey. The second component consists of the means of keeping a true course. In birds it is external in origin; that is, dependent on the environment. The wide surfaces and extensive lines passing through the visual fields are used not to direct the course followed, but to preserve the straightness of the course originally projected from the starting point. The object is attained by the maintenance of an equality of the distances extending from the bird to related surfaces and lines passing through the visual fields. Deviation from the course is indicated by an angular distortion appearing in the apparent paths of the surfaces and lines occupying the visual fields. Deviation is corrected during flight by an involuntary declination of the long axis of the bird's body contrary in direction and sufficient in degree to neutralize the rotation or distortion then apparent in the fields of vision.

NOTES ON THE BIRDS AROUND CARDIFF.

By J. Blake.

The Mistle-Thrush, Song-Thrush, and Blackbird are very common in the neighbourhood of Cardiff, and their nests can be found almost anywhere. They are all early breeders, and nests of all three are commonly found in March. The Ring-Ouzel is scarce, though last year a pair bred at the Alp's Quarry, near Cardiff, but the nest was robbed. I could tell the bird by the white patch on its breast. This is the only pair I have met with breeding in this district. The Whinchat and Stonechat are both fairly common and breed regularly. The Robin, of course, is very common. Last year I found a nest in a tool-box in a shed, and the birds succeeded in hatching out four young, although the door was locked for the greater part of the day. The birds entered the shed through a crack in the side.

The Greater Whitethroat is common, but the Lesser Whitethroat is rather scarce, although I came across several pairs breeding this year. One nest I found was situated about five yards from the nest of a pair of Greater Whitethroats. The Blackcap and Garden-Warbler breed regularly, the latter being the scarcer.

The Golden-crested Wren, Willow-Wren, Wood-Wren, and Chiffchaff breed regularly.

The Nightingale, although it is becoming scarcer, usually breeds every year. The Reed-Warbler and Sedge-Warbler breed regularly in suitable localities. Last year I came across a pair of Marsh-Warblers breeding near St. Fagans, which is, I think, the first time they have been observed breeding in Glamorgan. The nest contained three eggs, bluish white in ground colour and blotched with dark brown, but unfortunately these were taken.

The Grasshopper-Warbler is scarce, but a pair usually breed on the Court-y-ralla Estate, near Cardiff.

The Hedge-Sparrow, Linnet, Chaffinch, Greenfinch, and Wren are very common, and breed regularly.

The Dipper is scarce, as there are not many suitable localities for it in this district. A pair usually breed at Radyr Quarry, although there is no rushing water there; but in all probability the birds frequent the River Taf, which is not far away, and flows very rapidly at that point. The nest is always placed in a fissure of the rock, and the birds breed very early.

Of the Titmice, the Long-tailed Tit, Great Tit, Coal-Tit and Blue Tit are common, and breed regularly. The Nuthatch breeds occasionally

The Pied Wagtail is very common, but their nests are very hard to find unless the parent birds are carefully watched. The Yellow Wagtail usually breeds in this district.

The Meadow-Pipit and Tree-Pipit breed regularly, as does the Skylark. The Spotted Flycatcher is very common and nests almost anywhere. The Red-backed Shrike is on the decrease, but it still breeds regularly.

The Swallow and Swift are very common, but the House-Martin is on the decrease. The Sand-Martin breeds regularly.

The Tree-creeper and Goldfinch breed regularly.

The Tree-Sparrow is scarce. I have observed a few pairs breeding at Radyr, and a pair bred at Llandaff Fields a few years ago. The Bullfinch is very common, and a pair breed regularly in Radyr Woods. The Yellow Bunting is very common.

The Magpie, although persecuted by gamekeepers, continues to breed in fair numbers in this district. The Jackdaw is very common, and there are large colonies at the Alps Quarry and the Little Garth. The Carrion-Crow is fairly common.

The Rook is very common and there are several large rookeries in the district.

The three Woodpeckers are to be found in our district, the Green Woodpecker being very common. The Kingfisher is fairly common, and I have seen three in one morning along the River Taff. The Cuckoo is very common.

The Barn-Owl is dying out around Cardiff, but last year I came across three pairs breeding within a few yards of one another. There was a clump of trees, about half-a-dozen, in

the middle of a field. In this clump of trees I found the following nests:—Carrion Crow's, Kestrel's, and the Barn Owls'. The Kestrel's nest was in the same tree as a pair of Barn-Owls', and was situated in a kind of shelf in the tree, the bottom of which was covered with fine wood. The Kestrels succeeded in hatching out four young, but the Carrion-Crows were less fortunate, as the hen was shot before the eggs were hatched, and I found her dead under the tree containing the nest. Two pairs of Owls hatched out their young successfully, the third having their eggs taken. The latter pair had their nest, if such it can be called, at the bottom of a hollow tree, the entrance being about three feet from the eggs. Once, on climbing the tree, I found the two birds asleep on the eggs, and it was not until I actually caught hold of them that they woke up! The nest then contained three eggs, but these were afterwards taken. Another pair had their nest in a kind of tunnel branching off from the middle of a hollow tree. At the bottom of the tree there was a large hole. Once, on approaching the tree, I heard a loud shuffling noise inside when, all of sudden, four fully-fledged young Owls came out of the hole at the bottom of the tree and flew leisurely away. I hope these Owls will return next year, when I hope to make further observations.

A pair of Barn-Owls breed regularly in a hollow tree in Llandaff Fields, although hundreds of people pass the tree every day.

The Sparrow-Hawk, although decreasing every year, still breeds regularly in certain localities.

The Ring-Dove is exceedingly common and breeds regularly.

The Wild Duck is very common, and I have found its nest far away from any water. The Moorhen is the commonest water bird in our district, and it breeds near almost any pond.

The Ringed Plover and Oystercatcher breed at suitable places along the coast.

The Lapwing is very common, and I have found as many as twenty-six eggs in one afternoon, all within the radius of a mile.

The Herring-Gull is the commonest Gull in this district, and in the winter large flocks come to Llandaff Fields and Cardiff

Arms Park to feed. They breed at the Steep Holm and at suitable places along the coast.

The Little Grebe breeds occasionally, and I was pleased to see a pair breed at Fairwater last year. First of all, one egg was laid but this was taken. The bird laid more eggs but these were also taken. She then built a fresh nest and laid six eggs. Four of these were taken, but she laid two more, and finally succeeded in hatching out four young.

In the winter, small flocks of Snipe may be seen in fields around Cardiff, and a few pairs remain to breed.

In addition to the birds above-mentioned, the following breed either occasionally or regularly:—Corn-Bunting, Reed Bunting, Coot, Corn-Crake, Stock Dove, Hawfinch, Heron, Jay, Merlin, Partridge, Pheasant, Lesser Redpoll, House-Sparrow, Mute Swan, Wheatear, Wood-Lark.

A DIARY OF ORNITHOLOGICAL OBSERVATION MADE IN ICELAND DURING JUNE AND JULY, 1912.

By Edmund Selous.

(Continued from vol. xviii. (1914), p. 225.)

June 22nd.—(I cannot now account for the intervening days.) I have been alone in my tent with the Merlins again, from a little after midday when it was first pitched. There are now young in the nest, and the female bird sits covering them, as though she were still incubating, but raised a little higher. At about 12.50 p.m. there is the twittering call of the male, and the female flies off. I hear one or both of them crying in the near neighbourhood of the nest, and, at a minute or two before 1, the female returns, but I cannot make out that she brings anything with her, or feeds the young. She continues to brood them merely, and, very shortly, flies off again, and, through the window of my tent, I am now able to follow her. She makes a sweep down the mountain side, then back again, and perches on a salient stone. From this, she in a moment flies down the mountain again, and circles over the flat lands below, as though with a view to seize prey. Nothing comes of this, however, and, in another minute or so—at about 1.15—she returns, unladen, to the nest, and once more broods her young; the latter look very small, and as though they had not long been hatched. This sortie seemed to be quite on the hen bird's own account—there was no sign of the male—yet she has not caught anything in it, either for herself or the young. At 1.20 p.m. she sweeps suddenly down from the ledge, without any cry or warning. Then, sweeping up again, over the side of the gorge, she perches on a jagged piece of brown stone, the mountain being strewn with these. I hear a twittering, but it does not appear to proceed from her, and, the next instant, she jumps from the stone and seizes something quite near it, upon the ground. Then, flying with this to another stone, she begins to devour it. Clearly then this cry (which was repeated once or twice) came from the male, or, at least, which is more essential, he had come, for the female simply swept from the nest to the stone, and had nothing when she alighted upon it. What she seized on the

ground must have been placed there for her by the male, who, like the male Sparrow-Hawk, seems to play the part of purveyor in the domestic economy of the nest. I watched the female feeding for a minute or two, but in trying to focus the glasses a little better, though they were well enough as they were, I lost her, and could not pick her up again on the great hillside. In another moment or two, however, she flew on to the nest, carrying something which I could not recognize, but which I thought looked like a large greyish mouse. Standing upon this, she tore piece after piece from it, giving most of them to the chicks, but sometimes swallowing one herself. She then, at 1.30, brooded the chicks, so that the feeding took ten minutes. I could clearly see that some portions of what the chicks received represented the intestinal canal, whilst others, from their dark red—almost black—colour, seemed to be the liver or some other internal organ. The chicks all stretched up in the nest to receive their portions, so that one of the eggs cannot have been hatched, for there were five. Their coating of down seems, at this early age, to cling close to their bodies, suggesting a sheared sheep. The chicks did not behave themselves greedily. There was no undue eagerness or snatching from one another.

1.58 or 1.59. Female off in silence and without any warning, so that I only know of her departure by looking up and finding the ledge without her, a moment after she has been there. I then go to a higher point up the side of the gorge, from which I can look down into the nest. I cannot make out any kind of remains in it, though they ought to be plain enough, if there—the unhatched fifth egg lies there conspicuously (in its original position apparently), the chicks being four in number. Before I got to the tent, again, the bird was back, and flying round with anxious twittering—there seems to be only this one cry. As soon as I had entered the tent, however, from the end away from her, I saw her on the ledge again. She had brought nothing in with her.

2.40. Bird off in silence, as before, but this time I see her take flight. I follow her for a little, lose her for a moment, then, glancing up through the window of the tent see both her and the male, one above the other, pausing, as it were, in the air—he uppermost, as though they had just met or were about to

meet. Then she sweeps away to the nest, and he passes once or twice before it, from side to side of the gorge. It looks as though the female, having seen the male, had expected him to be bringing her something and flown to receive it of him, but if so she was disappointed, and returned unladen to the nest, having hardly been away a minute.

3.37 p.m. Bird off, and returns, unladen, at 3.42. She went silently and suddenly, and there was no cry or other sign of the male. In less than another minute she again sweeps away—all as before—returning very shortly, and then again, about 3.46, and returns at 3.50, still unladen. In the interval between one or other of these flights, she walked a little way out of the nest, along the ledge, pulled at or picked some of the grass, laid it down, or made as though doing so, and then went through some of those curious actions which I have recorded of her, and also once of the male, during the incubatory period. These can now have nothing to do with the eggs, nor, being made outside the nest, with the chicks either. Inferentially, therefore, they have nothing, at any time, to do with them—they are not domestic actions. They follow, however, upon the pulling or plucking of grass, which is a nidificatory act, and have before been gone through on the nest itself, so that here we seem to have the true bond of association. Yet what, in themselves, can such movements—or some of them—have to do with the actual construction of the nest, and why do they so closely resemble those which, in another bird—the Peewit—seem to proceed out of a sort of sexual frenzy, but, as a result of, or, at least concomitantly with which, a nest-like depression in the ground is produced? * All this we can understand by supposing that it is out of such mere physiological movements that the nidificatory instinct has been evolved. It is easier to imagine the process by which sexual display may also have grown out of them, and, for my part, I have little doubt of this.

A little after this, there is the twittering of the male Merlin, more faint than usual. The female does not seem immediately to remark it, but, all at once, as though she did, she flies over

* From more recent observation I can now say that, to a certain limited extent, the male Peewit *lines* this depression. The actions alluded to I have already described in the 'Zoologist' for April, 1902. When last witnessed they seemed to me even more salient, showing how marked and peculiar they are.

the side of the gorge as usual; it is always the same side. She dips just behind the shoulder of a little rise, near to and parallel with the next ravine (just where she has before, when the male has come in whilst she was incubating) and from above this, in a few moments, go up some white or lightish-coloured objects which have all the appearance of feathers. All at once I see the male bird standing higher up the slope, and, in a little, he flies in the direction of where the female has disappeared, and disappearing himself, in the same way, an instant afterwards more feathers fly up. Then, shortly, the female appears, carrying in her claws the body of a dead bird (as is soon evident), from which a great part of the feathers seem to be gone. She carries it to the ledge, and the male follows her there, and seems almost on the point of alighting, as if protesting playfully against this appropriation—I mean it has that appearance. The young are then fed—the same decorous scene as before. Their mother gives them small bits, and eats larger pieces herself. There is once a feather on a piece received by one of the chicks. He seems embarrassed by it, and the mother pulls it off. A big piece, partially feathered, she takes back and swallows herself, feathers and all. At 4.10 p.m. she flies off, makes some swift, graceful circlings—disporting herself apparently—and comes in again at 4.12. The feeding is not resumed, so that it has occupied a quarter of an hour—for it commenced at 3.55. In this instance, too, therefore, there can be no doubt that the male has brought in prey—a bird—which he has placed somewhere, and to which the female has flown. It is his business, evidently, to provide food for his wife and family, and hers to distribute it to the latter. From feathers going up again immediately on the disappearance of the male behind the rise, it looks as though he helped in this—it is probable indeed that he does the greater part of it where he first strikes down the prey. At 4.25 there is the twittering of the male again. The female turns her head about, looks surprised, as though she thought it a great deal too soon, and does not leave the ledge. She remains with the chicks for over an hour and a half, and then, at 6·5, goes suddenly off, and it is she, I think, who now twitters as she flies about. She shortly passes from my sight, and I do not see any meeting between her and the male, though

a subsequent crying which I hear may well be his. But at 6.9, only, I see her back on the nest and feeding the young, she having taken me by surprise. Through the glasses I have a very good view of her eviscerating the body of some creature, which an adhering feather, here and there, soon shows to be a bird. But these feathers are so occasional that it must certainly have been plucked, and for the mother not only to have caught but to have plucked a bird in something less than four minutes from leaving the nest does not seem probable. I have no doubt but that the male, as on previous occasions, has brought it for her. At 6.16 the feeding is over, and the bird, suddenly diving from the ledge, makes some beautiful upward and downward darts, curves, and circlings, apparently in pure joy of the motion—a well-earned recreation she seems to consider it, after the long and faithful performance of her parental duties. Yet, at 6.18, only, she flies in, again, and broods the chicks.

I now leave the tent, and return to it, again, at 8.30, to find the female bird still on the nest—to be sure she may have left it during the interval. At 8.50 there is the cry of the male, and, in an instant, she is off. I cannot follow her far, nor detect the meeting, though I still hear the cries. At 8.55 the female returns with a dead bird in her claws, which she lifts, with her beak, into the nest, holding it by the nape of the neck, so that it depends in a very corpse-like manner. Then, with repeated picks down and pulls up again, she feeds the chicks, and it is easy for me to see the process of disembowelment—a somewhat ghastly spectacle. Here, too, the feathers are not much in evidence, and must have been removed to a considerable extent. This fierce bird, but tender mother, feeds her chicks liberally, and, as usual, makes her own meal with theirs, swallowing a great mass at the last. She still gives them small pieces, though occasionally a bigger bit is accorded. Then suddenly, at 9.6, she sinks from the ledge, takes her usual little flight of a minute or two, returns, and broods the chicks. I then go to bed.

June 23*rd*.—The female is on the nest when I look, at a little past 7. She seems completely to cover up all her four chicks, and the feathers of the lower part of her body are often a good deal puffed out beyond the usual contour-lines. At 8.36 the nest is all at once empty (except for the chicks) when I look, my eye

having been upon the brooding just before. A few moments previously I had heard the squeaky little cry of the male, but subdued and low-sounding—the birds latterly, I think, have become more silent.

8.38. Female back and feeds chicks, which takes only four minutes. It would seem, therefore, as if the prey had been "broken up" on the ground, and she had only brought in a piece of it. This must, I think, have been the case, as I could not even catch sight of what she had. At 9.25 she leaves the nest and walks almost to the end of the ledge. It ends in a little immature hill; this she partly ascends, and begins to pick at the green growing grass upon it. She does this in a determined way, but I cannot quite make out that she does more than peck and pull at it—whether she actually plucks it, I mean. She then comes back, and when near to the nest does the same with the browner and less fresh-looking grass there. At 10.12 she goes off the nest, with a flutter, and is back, with prey, before 10.13. The chicks are then fed, which takes till 10.19 only. The male, I think, must have come close up, this time, but I heard no twitter—all was in silence. Going higher up the slope, so as to look down into the nest, it does not appear that the bird really covers her chicks. They lie now, at any rate, for the most part, uncovered just in front of her, and she sits with her wings down on either side, spread so as to touch the ground—the nest, by the way, is hardly more than the bare ground—as though to shield them. But my approach may have something to do with this, for I cannot look down into the nest without the bird upon it seeing me, and she may perhaps have detected or suspected me a moment or two before I peeped over the edge of the parapet.

At 11.2 or 3 a.m. the bird goes off, and, as she flies, I both see and hear the male, who takes his stand a good way off on the slope of the hill. The female comes flying towards him, and, when just over his head, makes, as she skims along, a little dip down, which may or may not have been sufficient to enable her to take something from him, but certainly not from the ground. She passes on, over the top of a rise, some way off, and, in a moment or two—about 11.15—is back at the nest, bringing nothing with her. There has, I think, been no further meeting between her and the male. My reading is that the dip down of

the female bird towards the male, as she skimmed over him, was on the expectation of his having brought in booty, which was either not the case, or else he withheld it from her, probably the latter, for in another two or three minutes only the cry of the male is again heard, the female again flies off, and returns, now, almost directly, with something with which she feeds the young. At 12.55 the male cries and the female goes off. She returns with prey, in a few minutes, feeds the chicks, and, at about 1.5, flies out again. She is soon off, but soon back again, and is now away till 1.38—this and once before, during the incubatory period, when she left it for twenty-eight minutes, make her two longest absences from the nest. During a part of this time the male is in my sight, standing first on one promontory of the walls of the ravine, and then another. I watch him for some time, wishing to make sure of his identity, and whilst I am doing so he rises, and, following him with the glasses, I see him descend upon the female, who is standing on a similar prominence, a little way on, and coition is effected.

At 1.53 the female again flies off the nest, in response to the cry of the male. I watch her down over the brow of a rise, in good view, but which just hides her. In just a minute, however, she returns with a bird, and feeds the chicks, a long white entrail playing a prominent part in the meal. The mother gives them small bits of it, for the most part, and twice when they have a larger piece, she removes it, again, from their bills, and swallows it herself. This is not done greedily, but carefully. The chicks also feed decorously as they have hitherto. Neither now or upon any former occasion has there been anything that can be called plucking or pluming of the bird brought in, upon the nest; a feather or two may have been removed, but nothing more important. Evidently the nest is not thought the right place for this preliminary. As for the species of bird forming the prey, both now and generally, I can only go by probabilities and suppose it to be the Meadow-Pipit, which is very common over the land here, but in this I may be mistaken, the more or less plucked and always (I think) decapitated state of the victim making it difficult to judge. Its size has generally seemed to me to favour this supposition, but, where only portions have been brought in, these may have been of a larger

species, Phalarope, perhaps, or Golden Plover, though I hardly think so.

After this I leave the tent and try to take up a position from which I may be able to see the actual transfer of prey from the male to the female Merlin, or the depositing of it by the former, but this I am unable to do. The small size of the birds, and the huge scale of the land contours they fly over, with the frequent rises and depressions, makes it difficult to follow them for long, or to pick them up again, when lost. Later in the afternoon, the female bird flies from the home-rock to the opposite side of the next ravine, and, coming down on a rough, stony surface, seizes something which is evidently a bird, for, as she bends her head and raises it again repeatedly, I see feathers flying about, showing that she is plucking the corpse. As she has flown straight to the spot and there has been the cry of the male just before, I make no doubt that this bird has been brought in for her by the latter, who may be quite near at the time. I see him shortly afterwards, in the neighbourhood, and, a minute or two later, the female flies to the nest again, but not carrying anything. She has either stored the prey—in which term simply leaving it where it was must be included—or made a meal off it herself. Upon my return to the tent, I re-pitch it in a different position, taking in a wider view of the surrounding country. It is 7 p.m., or thereabouts, by the time I get inside, and at 7.6 the female bird, having left the nest in response to the usual cry, flies to it again, with something that suggests the plucked sternum of a small bird, and I can see her plainly eviscerating it for the chicks. Having fed them, she covers them as usual. At 7.14 the male flies up, twittering, and settles on the great hillside. A moment afterwards, the female flies from the nest, and straight to him, and then *at* him, making a little grab, but flying on, without alighting, and disappearing over the edge of the next gorge. Shortly she reappears, though I cannot see from where, and comes flying to the ledge, on which she alights, holding in her claws what looks like a ball of entrails, and with this she again feeds the "little eyases." This takes her till 7.22, when she covers them. At or about 7.30 there is the cry of the male Merlin. The female remaining on the nest, he twitters again, and continues to do so at short intervals,

loudly and insistently, till she flies from the ledge. I have the glasses on her, and follow her with them. She crosses the home-gorge, perches on a salient point just above it, and rising again, immediately, as if she saw something, flies back to her own nesting-rock, on the top of which, as she descends upon it, the glasses show me the male, and from him, with the same little grab as the time before, I now see her take, if not actually receive, the prey—it is either from his claws or from the ground just beside them, as he stands, which seems more probable. With it she flies, once more, across the ravine, and coming down amongst a lot of black stones (or cinders) on the slope of the mountain, I see her transfer it from claw to beak and deposit it there. She then flies straight to the nest, bringing nothing, and covers the chicks. The whole episode has taken about a minute. Here then, at last, is the actual ocular proof (though hardly needed) of the male bringing in food for the female, with which both her own needs and those of the chicks are satisfied. If the supply is superabundant, or comes in too quickly, the female apparently leaves it here or there on the ground—what I have seen more suggests this than that there is any special storing-place or larder. If she is hungry and the young have had enough, she makes her meal away from the nest, but otherwise (or perhaps generally in any case) she eats something of what she brings them. That the female is also fed by the male during incubation is probable, for she sits almost constantly, at least during the last part of the time, and there are the same periodical visits, announced by the same twittering cry. Once, too, I have unmistakably seen her devouring something immediately or shortly after going off to the male. But that the latter is, at this time, far less assiduous in the bringing in of supplies than after the hatching of the eggs is also apparent. All this corresponds closely with the domesticities of the Sparrow-Hawk, but I have not yet, with these Merlins, seen a transfer of food in the air, though once there was a suggestion of it. With the Sparrow-Hawk this seems to be the ordinary way. This last was the nearest approach to the nest, with his booty, that I have seen the male Merlin make. He once followed the female almost on to the ledge, but he had then already made delivery to her.

(To be continued.)

NOTES AND QUERIES.

MAMMALIA.

A Grey Hare.—As we were beating a small allotment ground between here and Milcomb on September 19th last, a Hare got up at my feet. My companion's small boy was walking between us, and we were just wheeling. The Hare went straight for the boy, passing close to him, and went on in that line, so that I could not shoot at it. It was quite grey; not the colour of a wild Rabbit, but more like that of the domesticated variety called the "silver-grey." We could never find it again anywhere round there. Hares do not try to stay long in allotments; and this one had probably come out of some barley field when it was cut, and was on the move. Although I was told it had been seen, I never heard its fate; but so many Hares disappear quietly! This is the only time I ever saw a variety of the Hare in a wild state.—O. V. Aplin (Bloxham, Oxon).

Elephant Scratching with Fore-foot.—When the baby Elephant from the Malay Peninsula was exhibited at the Zoological Gardens a few years ago I noticed on two occasions that it employed its fore-foot when scratching itself on the flank. This struck me as a most remarkable action for an ungulate, even for one which, like the Elephant, has limbs of a far less specialized type than the order generally. As far as my observations had gone, mammalia only scratch with the fore-foot when they have the habit of using their fore-feet as hands; thus I have seen Monkeys, Kangaroos, and the Coypu Rat (*Myopotamus coypus*) scratch in this way. It would be interesting to know exactly what animals use the fore-foot in scratching themselves, and also when, if ever, the Elephant gives up the habit, if it prove to be a usual one. I have had but few opportunities of observing small Elephants, never having seen in India any individual as small as that above remarked on, or as the one exhibited previously with the King's collection from India.—F. Finn.

Mouse surviving a Fall from a Height.—The activity of *Mus musculus*, in comparison with allied species, has been commented on, but its endurance appears at least equally remarkable, in the light of an experience I had when at Oxford, and remember quite vividly, though it was a quarter of a century ago at least. I had caught the Mouse in one of the ordinary live-catching traps, and, thinking to

kill it more mercifully than by drowning, dropped it out of my window, which was at least three stories up—it might have been four. It fell on the hard gravel of the quadrangle path, but was not even stunned, running about—perhaps in a rather confused way—until one of the college servant boys saw and crushed it. I have also seen in Calcutta a Gecko Lizard fall down the well of a staircase from at least three stories up, landing on a stone pavement with a smack, and yet run off all right. Perhaps the small size of these creatures accounts for their endurance?—F. Finn.

AVES.

Green Sandpiper (Totanus ochropus) in Stour Valley. — On January 12th, 1915, Mr. Richardson, of Flatford, Suffolk, shot, out of a flock of small waders which were feeding in the flooded meadows in the valley of the River Stour, a bird he did not recognize. It was sent to me for identification, and I saw it was a specimen of the Green Sandpiper, and as Christy ('Birds of Essex') says it has not been found in Essex during January, it may be worth while to record it. The River Stour divides Essex from Suffolk, and a bird shot in the meadows near this river may be considered to belong to either county.—Henry Laver (Colchester).

The Meaning of "Katones."—The 'Itinerarium Wilhelmi Botoner,' commonly called "William of Worcester," was written about the end of the fifteenth century, and contains an early mention of St. Tudwal's Island and its birds. Writing in 1478, he gives some account of the islands off the Welsh coast. After mentioning Bardsey ("Berdesey," it is spelt; and this suggests that it simply means bird-island, and has nothing to do with bards) and its twenty thousand saints, and "Mewys-island" (still called Gull Islands, for there are two), he goes on:—"Insula Lastydenale in Wallia sequitur proxima insulæ de Meulx, ex parte orientali de Meulx-iland, . . . et non est populata nisi silvestres herbas, aves vocat mewys, kermererertes, et katones, et muscæ id est mowses." The book is supposed to be written in Latin, but French and English words are introduced freely. Moreover, the author evidently wrote down place-names and others from ear, and often got them more or less wrong, so that it is not always easy to identify islands. Some help can be had from Camden's maps, though both authors use names not in use now. "Lastydenale" would have been a greater difficulty had not the author repeated it further on, and then spelt it *Lastydewale*. It then became quite clear that he meant St. Tudwal's (pronounced Tydwal's),

and had terribly corrupted the name by going by ear. Possibly he had some idea of prefixing the French article. But even Camden prints the name "Stidwall" on his map. "Meulx-iland" must be a corruption of Mercross Island, used by Camden, but not used now. I should be very glad if any reader of the 'Zoologist' could suggest what "Katones" can be. One's thoughts naturally fly to Shearwaters; but I have been unable to find in any old book a name anything like "Katones."* Shearwaters are now called "Mackerel-cocks," but no *old* name for the bird seems to have been preserved in print for any part of England or Wales. Of Flatholm the author writes, "Repleta cum cuniculis." And his use of languages may be judged from what he writes of Puffin Island:—"Insula Prestholm proxima insulæ Anglesey, . . . et ibi crescunt cuniculæ et serpentes addyrs snakes, et arbores vocat elders; . . . et est ibi unum bay pro navibus salvandis in le north side insulæ vocat le round table."—O. V. Aplin (Bloxham).

A Letter from Thomas Pennant.—The following letter in my possession, written by Thomas Pennant to William Borlase (author of the 'Natural History of Cornwall,' 1758), endorsed 27th October, 176— (last figure doubtful), is, I think, worth printing:—

"Dear Sir,

"I am obliged to you for your favors, and greatly so for promising Mr. J. St. Aubyn's subscription to the Society. Mr. Morris, our President, tells me He has not heard anything of it, so I fear Mr. John's orders are neglected. I have received your valuable present of the 'History of Cornwal,' and as soon as the first Part of British Zoology appears I will send you an order for a copy of it. I am quite happy that we have at last settled the Dispute about the Identity of the Cornish Gannet. As you observe, the figure in Willoughby is wretched; but you will now see it finely executed (from a fresh subject) in the work in hand. You will find in the first Part three Birds that are styled Cornish, the Gannet Tarrock and Daw. Pray send me a brief Nat. Hist. of the first. When does it first appear: When go off: Are they very common with You &c.? Does the Tarrock breed with you; in what sort of place. As Birds go by different names I should still be glad to see all those you mention; for that is the only secure method of conviction. Be so good as to tie a label to the Leg of each with its name and color

* Might not "Katones" be a misreading for "Kahoues"? "Cahow" is a known West Indian word for a Shearwater.—Ed.

of the Irides; and if you can send the weight and measures; and pack them as dry as possible with something between each. The great grey Gull of your County I never saw. The Hagden or dark brown Gull is quite new to me and probably non descript. Therefore be assured I shall be impatient to see them. Direct the box to Richard Morris Esqre. at the Navy Office and advise Him of the Time and method of conveyance. I hope Mrs. Borlase is better than when you wrote last. I beg my compliments to her and am Dear Sir, with . . . esteem,

"Your most obedient Ser.,

"*Bychton. Octr. 27th.* T. PENNANT."

The really good figure of the Gannet in the 'British Zoology' was evidently executed, as Pennant says, from a fresh subject; and the specimen killed on September 30th, 1762, and sent to Pennant by Borlase was doubtless a preserved skin. With it Borlase sent the "brief Nat. Hist.' of the bird asked for, which Pennant printed *verbatim* in the 'Zoology.' The Great Grey Gull is believed to be the *Larus marinus* in immature dress, but it might have been a Glaucous Gull in some cases. The Tarrock is of course the young of the Kittiwake. Pennant, once converted to this view, retracted the opinion in the 1776 edition. Hagdown is a name given to the Great Shearwater, and the "Hagden or dark brown Gull" was doubtless the Sooty Shearwater (*Puffinus griseus*), and this is perhaps the earliest mention of it as a British bird.—O. V. APLIN (Bloxham).

Stone Pellets Cast by Curlews.—Wandering, lately, along the east side of this island (Cumbrae), I came to a stretch of grassland, 150 ft. above sea-level, where I found a pellet of small white stones—chiefly bits of quartz—which had obviously been brought up from the shore. I wondered what bird could have brought them there until, further along, I found a number of small heaps of stones with occasional bits of sea-shell amongst them, which proved to be similar pellets which had been washed down by rain. Finally I realized I was on a favourite roosting-place of the Curlews, which I had noticed them frequenting lately. Last Sunday I heard a few Curlews calling at night in a similar grassy hollow above my house, which they have not frequented lately; to-day I went up there and found two pellets. The pellets are about one inch long by half an inch broad, and consist of thirty to forty small bits of quartz, and weigh about four grams: some of them contain a few bits of shell, and one consists almost entirely of shell. Judging by the numbers of pellets found on the roosting-place, I should say that they are formed

occasionally and cast in the morning. I hope to be able to verify this by actual observation, but owing to the wariness of the Curlews it may not be possible to do so.—Richard Elmhirst.

PISCES.

Long Rough Dab in the Irish Sea.—In the 'Victoria County History of Lancashire' it is stated that the Long Rough Dab (*Drepanopsetta platessoides*) is very rare in the Irish Sea, indeed, so uncommon that there is no local name for it. The author adds that he has seen three or four specimens taken between Lancashire and the Isle of Man. In view of its rarity, it may be of interest to state that in July, 1909, the Common Terns on the Cumberland and North Lancashire coastline were feeding their young on very small specimens of this fish, of which I found a fair number on the nesting sites. In July, 1910, only a few odd specimens were seen, and in 1911–12 and 1913 it was entirely absent.—H. W. Robinson, M.B.O.U., F.Z.S.S. (Lancaster).

A Correction.—In a paper on "The Fauna of Reservoir Plants," published in the 'Zoologist,' vol. xviii., May, 1914, the present writer made the following statement on p. 185:—"In the Hawaiian Islands a species of *Eriocaulon* provides a habitation for the larvæ of a Culicid and for a species of Cyclopid Crustacean." Dr. A. Lutz, of the Instituto Oswaldo Cruz, Rio de Janeiro, who made this discovery, has called the writer's attention to the fact that it occurred *in Brazil*, not in the Hawaiian Islands. Moreover, the *Eriocaulon* should be described as growing in, but not as actually floating on, a marsh. Dr. Lutz referred to the matter in 1903 (Centralbl. f. Bakteriologie, Abt. 1, vol. 33, p. 291). The writer's apologies are due to him for this erroneous citation from his work. On the following page (186) of the paper in question, in referring to the fauna of *Pandanaceæ*, it was stated that these plants are trees with stilt-roots, and that various animals have been found between their leaf-bases in the Hawaiian and in the Seychelles Islands. This statement might have been more explicit. In the Seychelles the plants in question are indeed trees, being more than one endemic species of the genus *Pandanus*; but in the Hawaiian Islands the species referred to was a *climbing* member of the *Pandanaceæ*, *Freycinetia arnotti*, and the creature found in it was an Amphipod Crustacean of the genus *Orchestia*. This latter discovery was also made by Dr. Lutz, and is mentioned on pp. 284–5 of his work cited above.—Hugh Scott (University Museum of Zoology, Cambridge).

NOTICES OF NEW BOOKS.

Water Reptiles of the Past and Present. By Samuel Wendell Williston. University of Chicago Press.

Professor Williston's book, well illustrated by figures, many of which are by himself, is a welcome addition to the literature of extinct animals, more especially as particular endeavour has been made—and made successfully—to make the subject understandable to the non-scientific reader. The extinct sea-reptiles have always enjoyed a particularly wide-spread reputation, their remains being so numerous and well-preserved, so that the Ichthyosaurs and Plesiosaurs in particular are quite well known, as extinct forms go. There is much information about them here which will be new to many who have a general knowledge of them; full prominence is given to the external form of the Ichthyosaurs, now well known by fossilized outlines to have possessed a caudal fin, which Owen inferred they possessed, and several types of Plesiosaurs are discussed and figured, not only the familiar long-necked forms, but others with necks of varying length, including some whose necks were shorter than the head, which was broad. These, therefore, made some approach to the Crocodiles in form, and some of them with skulls five feet long armed with teeth, some of which were four inches in length, must have been more formidable than any other sea-reptiles. The author must be forgetting these when he says that the snake-like reptiles of the Mosasaurian or Pythonomorph group would probably be the only sea-reptiles dangerous to man, were all existing to-day. The Mosasaurs, however, were undoubtedly a very truculent lot, and the frequent injuries displayed by their remains show that they probably fought each other.

Curiously enough, young of this group have never come to light, and it is suggested that they may have been oviparous. In this case they no doubt came ashore to breed, though it is pointed out that their paddles, although less specialized than

those of the Ichthyosaurs and Plesiosaurs, were quite inadequate for support on the land, where, though they might have moved in a serpentine way, our author thinks they never went voluntarily. This is inconsistent with oviparous habits; but, after all, since Eels can move on shore and even travel some distance thereon, there is no reason why these air-breathing creatures could not have done as much. Their remains are so well preserved that even the existence of scales, although very small ones, is substantiated, and even bands of pigment have been traced in one specimen Professor Williston has examined. The shape of the head, as restored, suggests that of the Sea-Eels of the Murænoid type, known to be some of the most ferocious and aggressive of fishes, by modern experience as well as by the tales of wealthy and wicked Romans who used to throw delinquent slaves to their pet Murænas. Professor Williston considers these ancient Sea-Serpents to be "real Lizards, differing less from the living monitor Lizards than do the monitors from some other Land Lizards, especially the Amphisbænas and Chamæleons," and he remarks that Adrian Camper pointed out their real relationship more than a century ago.

Though not absolutely certainly a true Mosasaur, the recently discovered genus *Globidens* deserves mention on account of its extraordinary teeth, which, according to the life-size figure, had crowns of the size and shape of Barcelona nuts, indicating a diet of shellfish rather than of fishes proper.

Turning to more familiar types of reptiles, it is noteworthy that all the highly-specialized marine Crocodiles or Thalattosuchia have become extinct, while the semi-terrestrial Crocodiles and Alligators remain; specialization in reptiles seems very uniformly to have led to extinction.

The accounts of water-reptiles of the present are far less satisfactory than those of the ancient forms. Much more might have been said of the Sea-Snakes, the only large group of marine reptiles to-day, especially with regard to the genus *Platurus*, which forms a perfect link with Land-Snakes, and whose members often come on shore, unlike all the rest; and with regard to the curious parallelism in development between these Snakes and the Plesiosaurs, some being stout and of nearly uniform calibre, while others taper extraordinarily in the

anterior part of their length, and have very diminutive heads. Something also might have been said about *the* Sea-Serpent, so often reported by sailors, and within the last few years actually seen by two such well-known naturalists as Messrs. Meade-Waldo and Nicoll, during the cruise of the 'Valhalla.'

Even with more familiar reptiles there are some errors which will need correction in a subsequent edition, in the event of this being called for; it is most incorrect to say that in the Marsh Tortoises (*Emydidæ*) only the two or three middle toes have claws, the normal number of claws being five on the fore-foot and four on the hind; while the Box-Tortoise is not, as stated, strictly vegetarian, but largely an animal-feeder. Moreover, the "Flying Dragons" incidentally mentioned are not Ceylonese, as stated, but have a wide range over other parts of the Oriental region, from Malabar to the Moluccas.

Bulletin of the British Ornithologists' Club, vol. xxxiv. Edited by W. R. Ogilvie-Grant. London: Witherby & Co. December, 1914.

This volume is entirely devoted to the report of the immigrations of summer residents in the spring of 1913, and notes on the migratory movements and records received from lighthouses and vessels during the autumn of 1912. It forms the ninth of the series issued by the British Ornithologists' Union Migration Committee; and after the appearance of a tenth report to be issued during the present year, the results of the enquiry will, we are told, be summarized in a final volume, which will, of course, be looked forward to with eager interest by numerous observers. It is noted that increase in the number of records supplied by observers continues, and the Migration Committee particularly congratulate themselves on being able to get returns from the Caskets Lighthouse, which had proved impossible until the appointment of Mr. R. E. Wilson to that station, a very important one for migration movements.

Comment is also made on the numerous instances of summer visitors which had apparently not migrated at all from the south and west, and on the unusually early arrival of others, for which the mild weather is considered—no doubt rightly—to be responsible.

With regard to the localities and arrival of the various species, it is to be noted that the Grasshopper-Warbler and Land-Rail are noted as having arrived only on the western half of the south coast, while the Reed-Warbler, Red-backed Shrike, Wryneck and Turtle-Dove, came in on the south-east coast, from Suffolk to Hampshire. Many species were observed to begin to depart very early in the autumn, but yet there were great migrations during November, even more than during the previous month, the main migrations having apparently been delayed till the middle of the latter. It is gratifying to find, in this connection, that special mention is made of Mr. B. B. Riviere's observations in the 'Zoologist' of 1913, which are stated to have "added considerably to our knowledge of the coasting character of some of these autumn movements." The Report is of course indispensable to all who are studying migration.

The House-Fly. By C. Gordon Hewitt, D.Sc., F.R.S.C. Cambridge Zoological Series. Cambridge: University Press. 1914.

It is probable that no more valuable and important monograph of any insect has been published than this, in which Dr. Hewitt, formerly Lecturer on Economic Zoology in the University of Manchester, and now Dominion Entomologist of Canada, discusses from every point of view the most familiar of all insects, if not of all living things. The whole history of the Fly in all its stages is exhaustively discussed, the morphology being thoroughly worked out, while equal attention is given to its reproductive, feeding, and other habits. Natural enemies and parasites are also dealt with, as are other species of Flies frequenting houses, such as the Lesser House-Fly (*Fannia canicularis*) and the biting Stable-Fly (*Stomoxys calcitrans*). These subjects occupy the first four sections of the work, while the last two are occupied with the extremely important subject of the relation of House-Flies to disease, now so widely recognized, and the various methods of control which are being attempted. The work is most fully and beautifully illustrated by both coloured and uncoloured figures, most of them the work of the author.

"It is," he says, "not intended as a popular treatise on the subject," but "primarily intended for the use of entomologists, medical men, health officers, and others similarly engaged or interested in the subject, and it is hoped that it will be of value to students." There is no doubt of this, and it is certainly a work which all interested in general zoology will find invaluable, and one which should be widely disseminated in public libraries.

There is so much of interest in a work like this that it is difficult to make selections, but particular attention may be drawn to some special points. One is the extreme omnivorousness of the maggot of *Musca domestica*, which can apparently extract nutriment from almost any organic substance that is not too dry, though its favourite pabulum, and that on which it develops best, is stable-manure. Another is the curious fact that among its enemies is to be noted the larva of its ally, the Cluster-Fly (*Muscina stabulans*), which attacks and devours the House-Fly maggot, although commonly feeding, like it, on miscellaneous animal and vegetable refuse. The list of diseases which can be transmitted by House-Flies is something appalling; not only are bacteria transferred by the feet of the insect, soiled by contact with filth, to our food and drink and our persons, but the habit of the Fly of disgorging a part of its last meal on whatever it is partaking of at the moment, if this needs softening, is a potent factor in disease-dissemination.

It is also interesting to note that, though the general realization of the danger from this household insect is quite recent, it was suspected as a disease-carrier as long ago as 1577 by Mercurialis, while at long intervals it has been again accused. A very full bibliography, occupying thirty-five pages, concludes this masterly contribution, as valuable to pure science as to the utilitarian application of our knowledge.

Annals of Tropical Medicine and Parasitology. Vol. viii. No. 3. Liverpool: University Press. December 15th, 1914.

This journal contains a very interesting paper by Dr. H. B. Fantham and Dr. Annie Porter, on a new Microsporidium infesting humble-bees, and the diseases it induces in them. The organism in question has been appropriately named *Nosema*

bombi, and is allied to *Nosema apis*, the cause of the "Isle of Wight disease" in hive-bees, of which so much has been heard of late. Although *Bombus agrorum* is the chief sufferer, other species of *Bombus—hortorum, latreillelus, lapidarius, sylvarum* and *terrestris*—may suffer, especially the last-named; while the hive-bee, *Apis mellifica*, and *A. florea* may also be affected. The medium of infection is bee-food and drink soiled by the dejecta of infected bees, and even larvæ may contract the disease. Different species of humble-bees may also infect each other, and both hive- and humble-bees may suffer at the same time both from *Nosema apis* and *N. bombi*. Hive-bees become infected from the attempts of humble-bees to rob them, and the pathogenic action of the parasite is in them accelerated, while similarly robber humble-bees contract the "Isle of Wight disease" in a virulent form.

The sick humble-bees infected by *Nosema bombi* generally die, often previously crawling about unable to fly, and exhibiting great irritability and readiness to sting. Artificially infected humble-bees have shown the commencing infection in forty-eight hours, and in some districts practically all individuals of *B. agrorum* were found to be infected.

The disease thus assumes considerable economic importance in view of the known services of humble-bees in fertilizing red clover, and the authors recommend as measures in keeping up the humble-bee stock the destruction of all infected humble-bee colonies and dead or dying bees, and the discouragement of the taking of humble-bee nests by children. Considering the part played by Field Mice also in such destruction of nests, the preservation of Owls and Kestrels might also have been recommended in this connection. Another paper with a peculiar if rather gruesome interest is one written (in French) by Dr. J. Schwetz on the morphology and biology of the larva of the fly *Auchmeromyia luteola*, known as the "Congo floor maggot." This is a blood-sucking maggot which infests the floors of native huts, creeping out to attack people who are sleeping on the ground or on low bedsteads. Dr. Schwetz has been studying it at Kabinda, and though forced to leave his investigations incomplete for the present, has yet succeeded in establishing some interesting points in the habits of this

particularly repulsive pest. He finds that the larvæ possess great vitality and powers of fasting; newly-hatched larvæ (which appear in about forty-eight hours after the laying of the eggs) lived for ten to twelve days without feeding, and of three small larvæ which were red, showing they had recently sucked blood, put into a jar on September 23rd, while two were dead and dried up on November 27th, one was still alive and had even increased to a medium size. The pupation of some large red larvæ took place in a week after they had been bottled up. Pupæ, however, were far more delicate than larvæ, and were easily killed by movement of the sand with which they had been enclosed.

In the experimental jars the larvæ burrowed in the sand during the day, but were found crawling actively about on its surface at night, nor did the light of a lamp close by diminish their activity. Yet in nature, so natives agreed in informing the author, the maggots bite by day if one lay down, so that the reason why night was the chief time for their attacks seemed to be that night is the usual sleeping time for humanity.

It is possible, as Dr. Schwetz says, that the influence of these maggots is more noxious than is supposed. At any rate, considering their disgusting character, it is satisfactory to note that they could be kept under control fairly easily, for he found that, after giving rewards to native children for adult flies as well as maggots during a couple of months, he could only get very few of the latter, and those very small and in a fasting state. The fly is a smoky-buff insect with darker markings, and the males, which are nearly twice as numerous as the females, are distinguished by a shorter abdomen.

Transactions of the Paisley Naturalists' Society. Vol. ii. Paisley: Alexander Gardney.

This neat little volume, the frontispiece of which is a coloured map of the county of Renfrewshire, is chiefly occupied by lists of the county plants, Macro-Lepidoptera, freshwater fishes and land vertebrates, accompanied in some cases by notes. The general get-up of the book and the character of the contents reflect great credit on the Society which publishes it, though it must be admitted that misprints are curiously numerous.

Renfrewshire for its size—it is the twenty-seventh in area of the thirty-three Scottish counties—presents a considerable variety of physical conditions, which affords diversity for the flora and fauna. The poverty of the latter in some respects is, however, rather remarkable; thus, among the butterflies, only fifteen species are recorded, and only seven of these are really common; even the ubiquitous small Tortoiseshell (*Vanessa urticæ*), which may be seen at times even in London streets, is noticed as abundant in "some seasons." The moths are better represented, but it is curious to read of that confirmed Cockney insect, the Vapourer (*Orgyia antiqua*)—whose larvæ amounted to a plague in London parks a few years ago—as "local; fairly common on moorlands." Among the Amphibia the usually scarce Palmated Newt (*Molge palmata*) is noted as equally common with the familiar *Molge vulgaris*, the Common Newt.

Among the notes on birds, the building of the Mistle-Thrush (*Turdus viscivorus*) on the tops of tombstones, with tree sites available, is noteworthy, as is the persistent residence of the Blackbird (*T. merula*) even in severe weather, when the Mistle-Thrush and many Song-Thrushes (*T. musicus*) emigrate. A very remarkable record also is that of six Gannets (*Sula bassana*) viewed passing over Thornliebank on June 29th, 1892, this place being about midway between the Firth of Clyde and the Clyde estuary, and so many miles from either. The lingering of the Wild Cat (*Felis catus*) up to as late a date as 1895 is a noteworthy record for the local Mammals.

EDITORIAL NOTES.

Mr. Patterson's notes ('Zoologist,' 1914, p. 4) on several abnormally-coloured Plaice occurring at the same place and time, and being of the same size, are of great interest. He is no doubt right about their being of the same brood, for in animals which lay such numerous eggs as teleostean fish there would be a probability of several abnormal specimens occurring at once. Even with such comparatively infertile creatures as birds, whole abnormal broods may occur. When in India we were told of the existence of a pair of the common Ring-necked Parrakeet (*Palæornis torquatus*) in the Patna

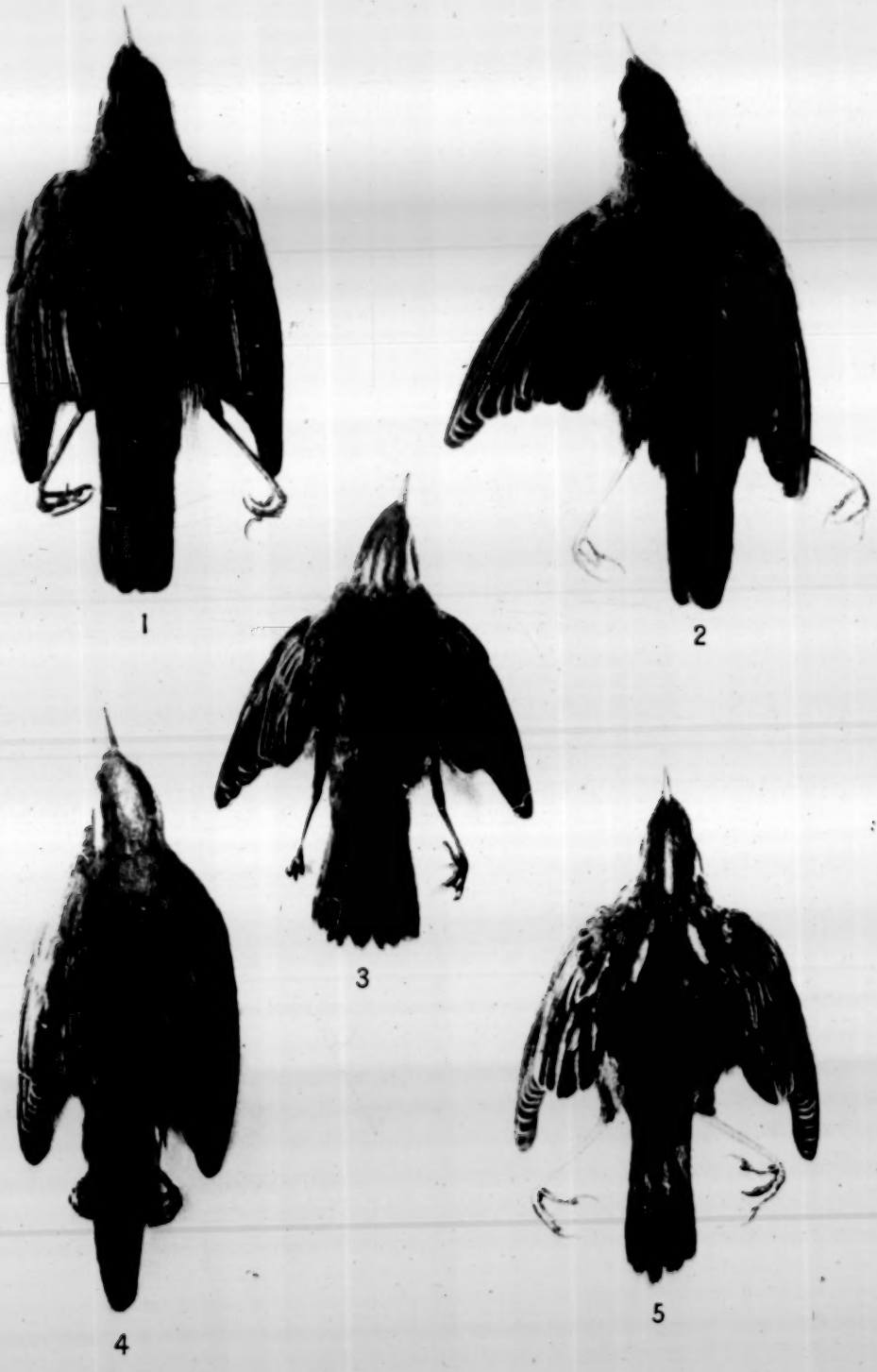
district, all of the brood of which were always yellow instead of green. They nested year after year in the same tree, and there was great local competition for the young, such lutinoes fetching a high price even in India; this no doubt accounts for their extreme rarity in Europe. The fact that such yellow varieties are now very rarely brought to Calcutta may indicate that this pair, or one of them, has met with some mishap, curtailing the always limited supply of the varietal individuals, for which there is always, as above remarked, a market. In our time in Calcutta we knew of two living examples of the lutino variety, and there must have been about half-a-dozen skins in the Museum, mostly, we believe, contributed by Rutledge, the animal dealer, who informed us of the lutino-producing pair above referred to.

The Mammalia of Hampshire and the Isle of Wight.—The Rev. J. E. Kelsall, The Rectory, New Milton, writes:—"Having been asked by the Hants Field Club to write a short account of our Mammalia, I should be very glad of help from your readers, especially in regard to the following species:—The rarer Bats (especially the Lesser Horseshoe and the Hairy-armed), the Marten (certainly extinct), the Polecat, the Black Rat, the Harvest Mouse, the Yellow-necked Mouse, and the Cetacea. The Field Club have already published lists of the birds and reptiles."

We hope readers will be able to oblige Mr. Kelsall, and at the same time swell our notes on Mammalia, a group on which the observations are very few compared with those on birds.

Miss W. Austen writes:—"I was wondering whether it would interest the readers of the 'Zoologist' to know that I saw a flock of about thirty Long-tailed Tits, very lively and talkative, in the garden of Studio 3, Warwick Avenue, Maida Hill, last October 1st. Is this not a somewhat uncommon bird to be in a London garden? After scrambling about in the poplar over my studio, they flew to the plane trees on the Regent's Canal bank. Of course I may be wrong in supposing anything unusual in their appearance in town." Miss Austen is certainly right in thinking the occurrence a curious one; we have personally never seen the Long-tailed Tit anywhere in London that we can remember, though London birds have been a special study of ours for years.

Errata.—In 'Zoologist,' January, 1914, on p. 11, *mustella* should read *mustela*; and on p. 25 *sturio* should read *sturio*.



Photos by C. J. Patten.

SEDGE-WARBLERS (Figs. 1, 2, 3, 4,) and AQUATIC WARBLER (Fig. 5).

From Tuskar Rock Light-Station. Showing plumage-markings of the upper parts.